Chesapeake Bay Ecopath with Ecosim Model

Overview

The NCBO has begun a number of projects related to ecosystem-based management, including the FEP. Further, the NCBO is funding the development of several multispecies approaches to fisheries research to aid the attainment of FEP goals. One such approach is the development of a Multispecies Virtual Population Assessment (MSVPA) model. The MSVPA will specifically address concerns in the CB regarding menhaden and fisheries for menhaden, as well as the impact of predators on menhaden. The NCBO also sponsored a workshop in March, 2002, with the aim of identifying what is known and not known of the state of suspension feeders, including oysters, clams and menhaden, in the CB. Several directions for future research were suggested as outcomes, and the NCBO received several RFPs for 2003 as a direct result.

The main tactic taken by the NCBO, however, towards implementing the FEP was to begin the development of an ecosystem model of the CB. The NCBO contracted a team of fisheries scientists from the University of British Columbia, as well as contracting through the CRC to have an expert modeler onsite, to begin the. The model being developed is an Ecopath with Ecosim (EwE) model, a trophic mass-balance model that has been used in a vast array of ecosystems. It is hoped that when completed, the model will help support and guide ongoing multispecies management and research, as well as help to address commitments made in the CBP Chesapeake 2000 Agreement. Most importantly, the model is intended to be a collaborative effort, involving all interested parties in the construction and evaluation of the model.

EwE overview

The foundation of the EwE suite is an Ecopath model, which creates a mass-balanced snapshot of an ecosystem represented by biomass 'pools' linked together by predation and fishing impacts. These pools consist of species, or groups of similar species. The Ecopath model's data requirements are relatively simple, and generally already available in the literature: biomass estimates, mortality estimates, consumption estimates, diet composition and fishery landings and values. These values are used to initialize Ecosim, which runs forward in time, predicting pool biomasses, fishery landings and other data. Comparing them against observed data, such as survey data or fishery CPUE, can test these predictions much in the same manner as is used for single species stock assessments.

Importantly, Ecosim also contains routines that can estimate the optimal fisheries policy by maximizing an objective function in terms of four areas, either separately or together with a weighted relative importance:

1. Mandated rebuilding – what actions must be taken if rebuilding a stock is necessary, for example due to legislation or court order;
2. Fishery rent – with the proper economic information inputs for fisheries represented in the model, individual fleet effort can be calculated that optimizes rents for all fleets combined;

3. Social value – optimizing the fleet effort while considering communities in terms employment;
4. Ecosystem health – optimizing the system in terms of biodiversity.

Many other routines included within the Ecosim code can allow for the representation of other ecological factors, such as environmental quality and indirect species to species impacts.

Workshops and training courses

In the spirit of the collaborative process, the first year of the modeling effort includes three workshops open to all interested parties. The workshops are meant to provide a forum where the models structure can be evaluated, and modifications made by the experts in the field. At present two workshops have already been held.

The first workshop was held in October, 2001, at the Patuxent Visitors Centre, in Laurel, MD. This workshop was very well attended with more than 50 participants from varied groups. The UBC Ecopath with Ecosim modeling team familiarized 65 registered participants from 17 organizations with concepts, applications, and examples of previous model applications of the models around the world. Following the general overview, participants were split into breakout groups to identify needed living resource data for incorporation into the model. Following preliminary model runs by the UBC team and modest modifications of suggested data inputs for 54 species and species-groups, a balanced model was obtained to serve as the foundation for subsequent exploration, refinement, and policy considerations. Several participants expressed the need to link water quality conditions to the Chesapeake Bay Ecopath with Ecosim model. Furthermore, the group identified 27 research and policy questions as potential issues that they hoped the model could address. The meeting ended with the appointment of a community derived advisory panel and four working groups to ensure continued model development over the next 6-month period.

While the interfaces and concepts involved with EwE are somewhat complex and initially overwhelming, it is hoped that in the future local researchers and other interested parties will be familiarized enough with the software and the CB model to use it independently. To that end, two training courses were held at the SERC, one in February, 2002, and one in May, 2002. The first course was well attended by 20 participants, and by the end of three days all had a practical grounding in the use and complexity of Ecopath. The second course was also well attended, with fifteen participants receiving instruction in the use of Ecosim, including validating to time series data and policy analysis. Further training courses may be run if sufficient interest arises.

Following a weekend hiatus, a three-day workshop of the Chesapeake Bay model was held at and co-sponsored by VIMS, attended by approximately fifteen individuals. The UBC modeling team presented and updated version of the foundation model that included some time series data. Various policy simulations were run with the model and the results, though preliminary, were insightful. On the final day, the original 27 policy questions were discussed, and by consensus a short-list of nine questions was proposed.

1. Can we increase oyster abundance through fisheries management?
2. Can we increase Blue crab abundance by managing fisheries and other species?
3. What is the optimal menhaden fisheries policy?
4. How many Striped bass can Chesapeake Bay support?
5. What is the optimal multi-fleet fisheries policy for Chesapeake Bay, in terms of economic, social and ecosystem benefits derived?
6. How might changes in primary productivity impact upper trophic levels?
7. How might climactic events impact upper trophic levels?
8. How might abiotic factors impact upper trophic levels?
9. What role do forage fish play in the dynamics of Chesapeake Bay?

Criteria considered in the selection of these questions included that they relate directly to fisheries management policy and/or that they address some of the CB2K goals.

In the future

In the near future the NCBO will be continuing to work with the academic and management community in the CB to build a useful model. The NCBO will be instrumental in the process of updating, documenting and verifying the model parameters. The NCBO is also dedicated to the collection and formatting of relevant time series data that will be used in the validation of the model itself. Two more workshops are also being initiated and planned by the NCBO: the first, an informal workshop to be held on July 23-24 at CBL for any interested parties to come and discuss/criticize the model; the second, to be held in April, 2003, where a validated model will be presented to the community and breakout groups will be formed to begin addressing the nine prioritized questions, as identified above. The modeling process is ongoing, and the NCBO is further dedicated to assisting and collaborating with all who wish to use the model in the foreseeable future.